

Long-term Engagement in Authentic Research with NASA (LEARN): Lessons Learned from an Innovative Model for Teacher Research Experiences

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The NASA LEARN Project is an innovative program that **provides long-term, year-round immersion in the practice of atmospheric science for middle and high school in-service teachers**. Working alongside NASA scientists and using authentic NASA Science Mission Directorate (SMD) Research and Analysis (R&A) related and mission-based research data, teachers **develop individual research topics** of interest during two weeks in the summer while on-site at NASA Langley. With continued, intensive mentoring and guidance of NASA scientists, the teachers further develop their research throughout the academic year through virtual group meetings and data team meetings mirroring scientific collaborations. Working with their mentors, teachers learn how scientists approach problems and gain a level of comfort with the research. Teachers act in the role of a scientist and experience how scientists interact at science team meetings and when presenting results at a conference. At the end of the first year, the LEARN teachers present scientific posters. The LEARN model incorporates **intensive support and mentoring, ongoing virtual and face-to-face check-ins, and flexibility to meet teachers' needs** on their research projects and in their classrooms.

The LEARN evaluation has focused on how an extended research experience for teachers spanning a full year influences teacher views of science and classroom integration of scientific principles. Early findings indicate that **teachers' perceptions of the scientific enterprise have changed, and that LEARN provided substantial resources to help them take real-world research to their students**. Teachers also valued the teamwork and cohort approach.



LEARN Teachers and their Research Topics

Cohort 1 (currently in their 2nd year)

2011 Lateral West Fire of Virginia

Alicia Dobyns: *York High School, Yorktown, VA*

Particulate matter and Air Quality in Oregon

Jodie Harnden: *Sunridge Middle School, Pendleton, OR*

Asthma and PM 2.5 in New York City

Samantha Adams: *Pan American International High School, Bronx, NY*

Formulating a Carbon Dioxide Budget- An Interdisciplinary Approach

Tim Kubinak: *John Yeates Middle School, Suffolk, VA*

CO₂, Ocean Acidification and Health of Coral Reefs

Roy Landers: *Sophia Academy, Atlanta, GA*

Physics and Instrumentation of atmospheric aerosol measurements in Greater DC Area

Ellen Babcock: *WT Woodson High School, Fairfax, VA*

Cohort 2 (currently in their 1st year)

Ozone in the Shenandoah National Park

Jackie Calder: *Henrico High School, Richmond, VA*

CO₂ sinks over changing vegetation in the US

Sue McIninch: *New Kent High School, New Kent, VA*

The Correlation of Autism Birth Rates and Surface Ozone in the United States

Susan Dougherty: *Stamford High School, Stamford, CT*

Protocol development for quantification of ozone induced stippling of plants

Gay Reilly: *Cooper Elementary, Smithfield, VA*

Air Quality in Michigan

Chris Marentette: *Groves High School, Beverly Hills, MI*

To see the final posters, please visit
<http://science-edu.larc.nasa.gov/LEARN/>

THE LEARN PD MODEL

2 Week Onsite Workshop

- GLOBE training in atmosphere protocols
- Scientist guest lectures to introduce NASA missions, projects, and critical research questions
- Large blocks of time to develop research topics with intensive guidance from scientist mentors, and to begin the process of accessing and working with data



Virtual Meetings

- Mirrors science research group meetings, while teachers independently pursue their research topics
- Weekly small group WebEx (webinar) discussions with scientist mentors, phasing to biweekly and then monthly during the school year
- Undergraduate research assistants provide real-time, one-on-one support to teachers, focusing particularly on data access, processing, and analysis tasks
- Virtual support persists throughout every stage of the LEARN model

Science Data Meeting

- Mirrors the NASA mission science team process
- In the winter, teachers convene to formally present their progress and to gather feedback from their peers and the scientist mentors
- Focuses on developing the science "story," and narrowing projects to appropriate scope and focus, with the goal of producing a final poster

Poster Presentation

- Mirrors the scientific conference format for presenting final results
- In the 2nd summer, teachers present their findings among each other, to the scientist mentors and project team, and to the public at NASA Langley
- Feedback and discussions prompt teachers to consider next steps for furthering their research and uncovering new, interesting questions

Lessons Learned: Addressing teacher needs

Mini-lessons on science content throughout the 2 weeks, rather than intense full-days, to avoid teachers being overwhelmed



Balance these lessons with hands-on activities "getting their hands dirty" with data



Provide lessons on downloading and formatting data into useable formats from multiple datasets

Select and teach basic use of a single piece of data analysis and figure-making software (e.g., Excel or Igor Pro)

Lessons Learned: Maintaining teachers through ongoing support

Teach the use of online webinar system (in this case, WebEx) while teachers are onsite, and incorporate time for practice

Virtual support keeps teachers engaged and connected to their scientist mentors and the LEARN support team throughout the experience. The LEARN team is always accessible, building relationships over time and helping when teachers are in need.

To keep participants engaged, it's important to:

- Be flexible in scheduling, to meet the teachers' time constraints – consider evenings and weekends!
- Maintain a respectful and collegial environment, in which the scientists and the teachers are all **colleagues engaged in learning together**.
- Focus meetings on a meaningful and helpful experience, rather than results – create a safe space for mistakes and confusion

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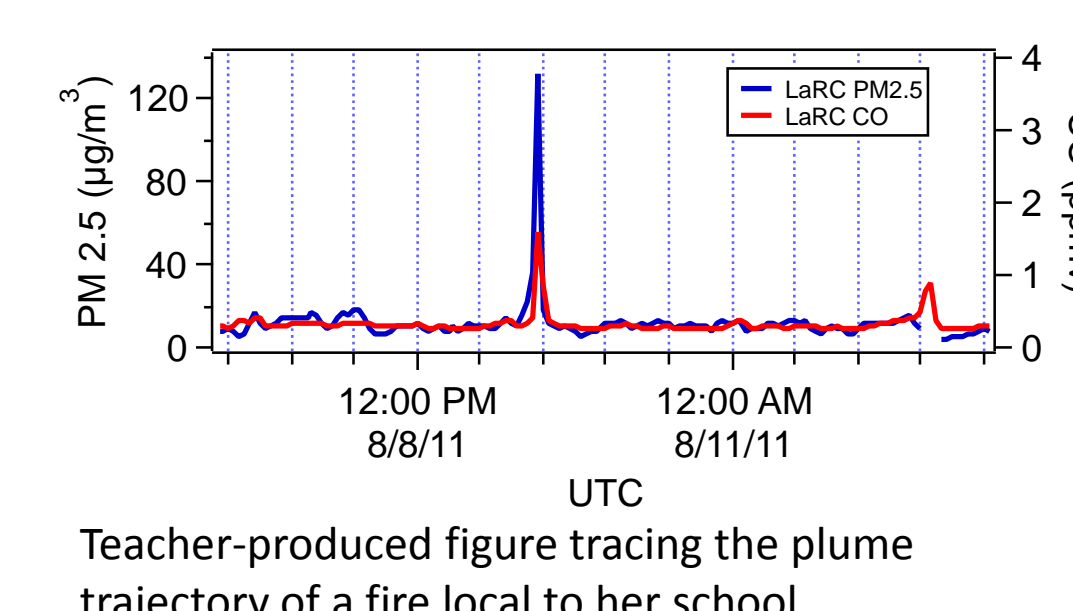
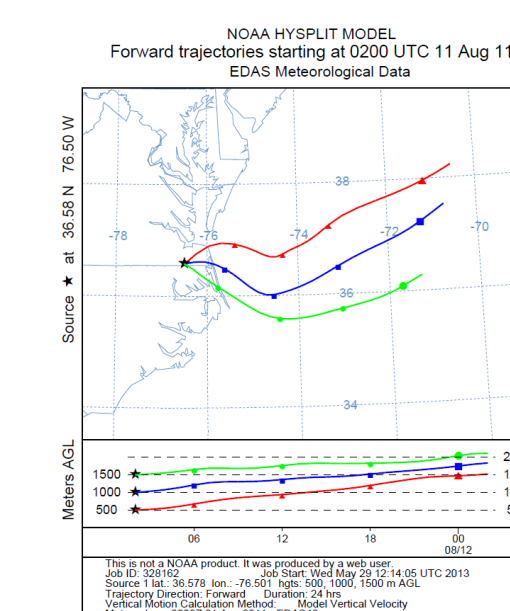
Lessons Learned: Making decisions & telling a science story

Teachers struggle to narrow and focus their science ideas to specific research topics that can be supported by accessible data and straightforward analyses. LEARN has found that teachers follow a path in developing their projects:

- Arriving at LEARN with ideas and interests
- Discovering the variety of data options, and possibly becoming overwhelmed
- Struggling to match their data and analysis tools to their topics of interest
- Learning how to narrow their question to fit available data and feasible analysis techniques

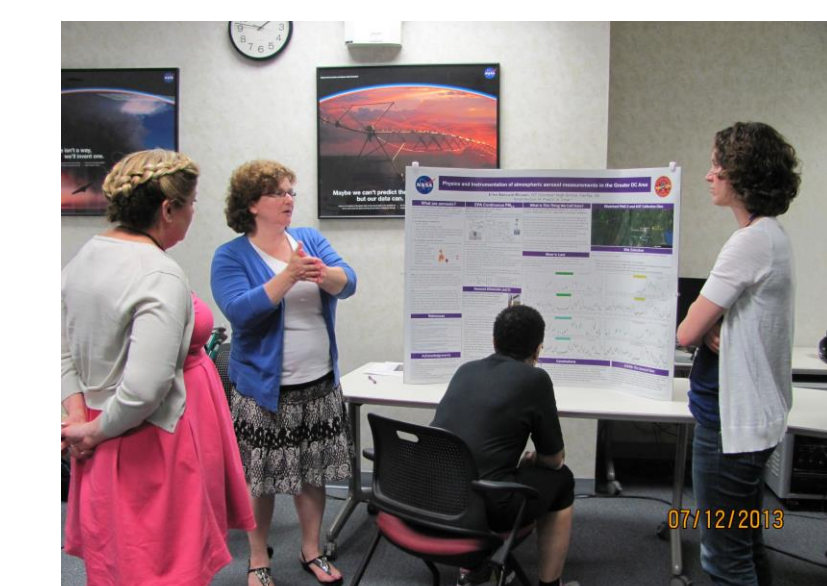
It's important to keep in mind that good research projects will:

- Be relevant to teachers' lives and interests, for instance, something in their local region
- Be meaningful to the teachers so that they are encouraged to persist and are able to focus their goals
- Use limited and focused data sets – once teachers are able to search and access NASA data, they quickly learn how large and wide-ranging the universe of data is

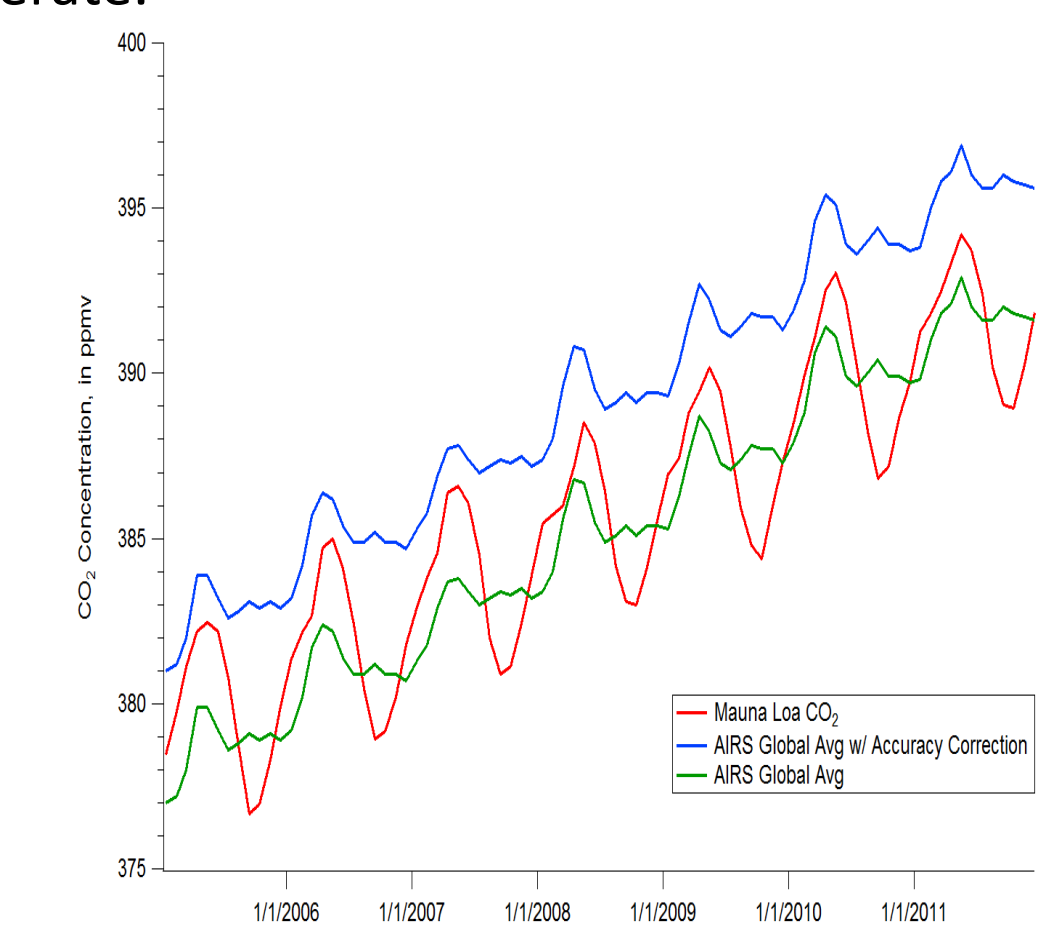


Lessons Learned: The LEARN experience comes full circle

Programs with multiple teacher cohorts can benefit by having the two cohorts overlap. In LEARN, Cohort 1 presents their posters to Cohort 2, serving as an introduction to the program. As a result, Cohort 2 have role models, while Cohort 1 teachers are able to practice their presentations in a low-pressure environment.



LEARN teachers are able to investigate an impressive range of scientifically-relevant topics, and become data- and analysis-literate.



Teacher-produced figure comparing 2 datasets, one with satellite measurements and one with surface measurements. This teacher was interested in how the long-term Mauna Loa record compared to shorter-term, but globally averaged, satellite observations.

LEARN teachers are also bringing their new-found knowledge back to their students!